The Variation of Tropical Cyclone Rainfall within the North Atlantic and Pacific as Observed from Satellites

Edward Rodgers[1]

Harold Pierce[2]

and Robert Adler[1]

Tropical cyclone monthly rainfall amounts are estimated from passive microwave satellite observations in the North Atlantic and in three equal geographical regions of the North Pacific (ie., Western, Central, and Eastern North Pacific). These satellite-derived rainfall amounts are used to assess the impact of tropical cyclone rainfall in altering the geographical, seasonal, and inter-annual distribution of the 1987-1989, 1991-1998 North Atlantic and Pacific rainfall during June-November when tropical cyclones are most abundant.

To estimate these tropical cyclone rainfall amounts, mean monthly rain rates are derived from the Defence Meteorological Satellite Program (DMSP) Special Sensor Microwave/ Radiometer (SSM/I) observations within 444 km radius of the center of those North Atlantic and Pacific tropical cylones that reached storm stage and greater. These rain rate observations are then multiplied by the number of hours in a given month. Mean monthly rainfall amounts are also constructed for all the other North Atlantic and Pacific raining systems during this eleven year period for the purpose of estimating the geographical distribution and intensity of rainfall contributed by non-tropical cyclone systems. Further, the combination of the non-tropical cyclone and tropical cyclone (i.e., total) rainfall is constructed to delineate the fractional amount that tropical cyclones contributed to the total North Pacific rainfall.

The main results from only the passive microwave-derived North Pacific mean monthly rainfall observations suggest the following: 1) tropical cyclones that occur during the tropical cyclone season of the entire eleven year period contribute, respectively, 13%, 3%, 4%, and 7% to the western, central, eastern, and the entire domain of the North Pacific total rainfall; 2) rainfall contributed by tropical cyclones alone are found to be greater in the western (100°-130° E) and the eastern (110°-120° W) tropical regions of the North Pacific than that found in the other regions of the North Pacific; 3) the greatest percentage of regional rainfall amounts contributed by, respectively, the western, central, and eastern North Pacific tropical cyclones are found northeast of the Philippine Islands (30%), equatorward of 15° N (30%), and off the lower Baja California coast (40%); 4) the strongest positive correlation (.53) between sea surface temperature anomalies in the equatorial eastern North Pacific and the North Pacific tropical cyclone mean monthly rainfall amounts occur in the eastern ocean basin, while the weakest correlation (.06) occurs in the central ocean basin; 5) the greatest amounts of tropical cyclone rain that fall at the higher latitudes occur in the western North Pacific during the late summer and fall months; 6) during the moderately strong and strong El Niño years of, respectively, 1987 and 1997, when the monsoon trough is well established, tropical cyclones appear to contribute more rainfall farther east and equatorward in the western and central North Pacific; and 7) warm SSTs anomalies can only directly effect tropical cyclone rainfall by enhancing surface energy flux if the tropical cyclone occur in regions where the environmental parameters favor tropical cyclone growth. Results from the passive microwave-derived North Atlantic mean monthly rainfall observations will be presented at the conference.

1 Laboratory of Atmospheres, NASA/Goddard Space Flight Center, Greenbelt MD. 20881

2 Science System and Application, Inc., Lanham, MD. 20701